Novel Approaches to the Study of Mechanisms of Behavior Change in Alcohol and Other Drug Use Disorders

MECHANISMS OF BEHAVIOR CHANGE SATELLITE COMMITTEE*

A T THE TURN OF THE 21ST CENTURY, scientific gains in the pursuit of more effective treatments for alcohol and other drug use disorders had plateaued, and very little was known about the underlying processes that mobilize and sustain positive behavior change (Huebner & Tonigan, 2007; Longabaugh, 2007). In response to calls to better understand these underlying processes (Longabaugh & Wirtz, 2002), the National Institute on Alcohol Abuse and Alcoholism (NIAAA) invested in research on the social, behavioral, psychological, and biological mechanisms that support reductions in alcohol use and other addictive behaviors. As a result, the first Mechanisms of Behavior Change (MOBC) meeting was held in 2004 as a satellite session to the annual meeting of the Research Society on Alcoholism. The MOBC satellite session has been held annually for the past 13 years, growing from 30 attendees in 2004 to more than 100 attendees in 2017.

NIAAA formalized its commitment to MOBC research via several key initiatives: (a) the publication of a special issue monograph in *Alcoholism: Clinical and Experimental Research* (Huebner & Tonigan, 2007); (b) the development of an NIAAA (2009, 2017) MOBC statement within the Strategic Research Plan; (c) the formation of a transdisciplinary MOBC team within NIAAA leadership; (d) the inclusion of a call for MOBC research in the main program announcement for Treatment, Services, and Recovery Research; (e) the issuing of program announcements, requests for applications, and a research funding announcement with MOBC aims; and (f) the funding of two MOBC-focused conference grants (R13 AA023455; U13 AA024013). NIAAA was not alone in its efforts to improve behavior change interventions. Concurrently, the National Institutes of Health Institute directors identified research on cross-cutting processes or mechanisms of change as a top scientific priority, and Science of Behavior Change became a program within the National Institutes of Health Common Fund, with its first funding opportunity announced in 2010.

MOBC initiatives within NIAAA and the National Institutes of Health Common Fund represented a shift away from the then-prevailing efficacy paradigm (e.g., randomized clinical trials) as the exclusive means for building knowledge to improve alcohol and other drug treatment outcomes. The efficacy paradigm often resulted in evidence-based modalities producing near-equivalent reductions in alcohol and other drug use (see, e.g., Miller & Wilbourne, 2002; Wampold, 2001; Wampold et al., 1997). That distinct treatment programs with unique behavior targets were producing near-equivalent effects made it impossible for a test of treatment efficacy to determine exactly how change was occurring (Magill & Longabaugh, 2013). Although equivalent outcomes across different treatments could suggest uniform processes of behavior change, behavior change outcomes often vary by person and contextual factors. If we do not know how individuals change addictive behaviors or who is most likely to benefit from addictive behavior treatment, then we do not know how to improve treatment effectiveness. This recognition has resulted in an increased focus on MOBCs, a sixfold increase in citations using mediation models to assess MOBCs within alcohol research studies, and the dissemination of conceptual frameworks (Kazdin & Nock, 2003) and statistical tools (e.g., Hayes, 2013; MacKinnon, 2008) to promote research on MOBCs. The scientific imperative included a call for multidisciplinary research teams, multilevel change process considerations, and increasingly sophisticated analytic methodologies (NIAAA Strategic Plan, 2009). Combined, these efforts represent an attempt to peel the onion of human behavior change initiation, maintenance, and relapse.

This Special Section in the *Journal of Studies on Alcohol and Drugs* is aimed at promoting the next phase in examining state-of-the-science approaches to studying MOBCs in addictive behaviors. We hope to highlight advances in this evolving literature and to guide researchers in developing new studies in MOBC science. Further, we offer a selec-

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tion of empirically supported mechanisms, both established and novel. The Special Section begins with two articles that consider issues related to study design and data analysis in MOBC research. Topics include approaches to improving causal inference in MOBC research and the development and testing of behavioral intervention theories through tests of statistical mediation. These articles provide timely reviews that address key methodological questions and issues of debate in MOBC research.

First, Finney (2018) explores limitations inherent to observational mediation design because of the inability to manipulate the purported mediator of interest. For example, it is often not feasible to randomly assign persons to different levels of hypothesized mechanisms (e.g., self-efficacy or social support). Because of this and other challenges, he raises the question of whether brief experimental manipulations could reasonably be expected to have enduring effects in the face of over-learned drinking behaviors. Finney provides recommendations for future MOBC research that may increase our confidence in causal attributions and includes examples of earlier experiments designed to directly manipulate mechanistic effects.

Second, O'Rourke and MacKinnon (2018) examine an ever-present question related to mediation tests in behavioral intervention research. Specifically, they consider conditions under which mediation may or may not be present in the absence of a main effect for the experimental condition. A core argument in this article is that even when intervention efficacy is not observed, there may be significant and meaningful mediation. Here, we have a central question for mediation design—when should mediation tests be pursued? The authors' work highlights conditions for the use of mediation tests to develop and refine behavioral intervention theories and underscores that studying MOBCs despite a nonsignificant main effect can advance understanding of how a given treatment is effective and for whom.

The next set of articles present advanced analytic approaches for testing MOBCs. First, Hallgren and colleagues (2018) consider greater levels of nuance in mediation questions, such as optimal methods for handling time when examining mechanisms of intervention effects. As the authors note, timing is everything and greater temporal resolution will be important in refining understanding of MOBCs. Moreover, it is important to recognize that alcohol and other drug treatments mobilize long-acting processes that will vary in strength over time. Statistical models should take these factors into account.

Many of the recommendations from Hallgren and colleagues are demonstrated in the next two empirical studies, both of which used variants of structural equation modeling (SEM) to test for mediator effects. The study by Treloar Padovano and Miranda (2018) applies multilevel SEM to the analysis of data from ecological momentary assessment among adolescents who use cannabis and who were enrolled in a randomized clinical trial examining the efficacy of topiramate for cannabis misuse. In this way, Treloar Padovano and colleagues take MOBC research into the natural environment and capitalize on analytic techniques that allow for disaggregating within- and between-person mechanisms of change in cannabis use. Results indicated that topiramate was more effective than placebo in reducing subjective high from cannabis, which resulted in less cannabis use at the daily level.

Next, Witkiewitz and colleagues (2018) present a novel application of latent class analysis in an SEM framework to examine coping skills as a mediator of outcomes for adults who received combined behavioral intervention and/or pharmacotherapy (acamprosate, naltrexone, and placebo) for alcohol use disorder. Results indicated that individuals who received the combined behavioral intervention were more likely to have a broader coping repertoire at the end of treatment and that coping repertoire significantly mediated the effect of treatment on drinking outcomes. Latent class mediation holds promise as a method for examining heterogeneity in the mechanisms through which individuals change. Together, these articles represent significant advances in theory and applied MOBC data analysis, present novel findings on mechanisms in two pharmacotherapy trials, and have clear implications for future MOBC research.

The sixth and seventh articles, by Eaton and colleagues (2018) and Houck and colleagues (2018), respectively, present recent findings on processes of change in motivational interviewing (MI). They focus on different populations (i.e., adolescent heavy drinkers in Eaton et al. and adults with alcohol use disorder in Houck et al.), but both studies found that what clients say in MI sessions (i.e., change talk and sustain talk) mediates the effects of MI-based intervention on alcohol-related outcomes, with different effects depending on the follow-up period that is evaluated. As such, both studies provided support for the notion that MI therapist skills can influence client statements about change and that those statements are associated with changes in behavior (i.e., support for the technical hypothesis of MI; Miller & Rose, 2009). These congruent results are notable given that the two designs varied on the type of MI providers examined (i.e., one used a peer-delivered intervention for adolescents and the other used master's-level clinicians who were well trained and closely supervised). Given that the effects of client change and sustain talk have been found in other therapeutic approaches (Lombardi et al., 2014; Moyers et al., 2007), these studies suggest the generalizability of client speech as a mechanism of action.

The Special Section concludes with novel perspectives on mechanisms of change. Noyes and colleagues (2018) address pretreatment (i.e., baseline) changes in drinking as they relate to process and outcomes among treatment-seeking adults with alcohol use disorder. Specifically, they examined change in drinking days and heavy drinking days during the month

before initiating cognitive–behavioral treatment. Noyes and colleagues found that pretreatment drinking moderated the relationship between self-efficacy measured during treatment and drinking days after treatment. This study suggests that the role of self-efficacy as a potential change mechanism may vary as a function of whether patients have already initiated behavior change before treatment begins. Noyes and colleagues indicate that baseline matters and that we need to further develop methods to study pretreatment behavior change.

In the final article, Buckman and colleagues (2018) provide an overview of the baroreflex, a novel mechanism involving a heart–brain feedback loop that affects physiological reactivity. Consideration of the baroreflex as an MOBC provides an important translational linkage between emotion regulation and behavioral outcomes. This linkage has direct application to intervening with addictive behaviors, and there may be fewer roadblocks to experimental manipulation when biological or physiological mediators are the mechanisms of interest. The work of Buckman and colleagues brings the MOBC science closer to multilevel (e.g., psychological level, biological level, and behavioral level) assessment and intervention with alcohol or other drug use disorders.

Overall, the Special Section provides a snapshot of current efforts to advance the state of MOBC science. As the contributions illustrate, there are important future avenues to consider. Specifically, the articles in the Special Section provide recommendations for future MOBC research to (a) improve the feasibility of experimental manipulation, (b) collect and analyze data with greater temporal resolution, (c) maximize the use of existing data sets to extract valid and reliable information to inform clinical practice, (d) consider the importance of pretreatment behavior change, and (e) examine multiple levels of analysis. Greater use of experiments, which is advocated by both the MOBC and Science of Behavior Change initiatives, would move the field a step closer to garnering convergent evidence for multilevel mechanisms of drinking behavior change. The use of biofeedback to modify emotion regulation is one such approach. Also, future trials can incorporate data collection methods, such as ecological momentary assessment to assess person-level change in the natural environment, that allow greater attention to be paid to how behaviors vary with time, how behavior outside treatment occurs, and how pretreatment behavior change affects later change processes. Each of these components of change is likely important for a more complete understanding of MOBCs. Moreover, as the world becomes more connected via mobile devices and applications, ecological momentary assessment and other intensive momentary data collection methods are becoming increasingly affordable, sophisticated, and user friendly. Finally, there remains a need to examine existing data from clinical trials that have already been conducted with high methodological rigor, even when no main effects of treatment were observed. Analyses of extant data sets can additionally examine theory-based, pretreatment moderators of MOBCs or changes in potential mechanisms during treatment.

In conclusion, significant strides have been made in understanding how and under what conditions individuals change addictive behavior. The question is deceptively simple, whereas the multifaceted nuances in behavior change require rigorous and complex design, sophisticated analytic methods, and strong theoretical rationale. This Special Section touches on a number of these important advances that can inform the emerging science of behavior change.

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